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BIOLOGICAL EVALUATION OF WESTERN BUDWORM ON THE LOGAN RANGER DISTRICT, WASATCH-CACHE NATIONAL FOREST, UTAH--1983

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ABSTRACT

During July 1983, aerial surveys of the Wasatch-Cache National Forest were made to map the progression of the western budworm, Choristoneura occidentalis Freeman. Visible defoliation was categorized as light, moderate or heavy. A total of 14,580 acres were defoliated on the Logan District, Wasatch-Cache National Forest.

Egg mass surveys were conducted on the Logan District. Average egg mass densitites were found to be at high levels, with predicted defoliation for 1984 to continue at moderate to heavy levels.

INTRODUCTION

The western budworm, Choristoneura occidentalis Freeman, continued to defoliate mixed conifer stands on the Logan District, Wasatch-Cache National Forest. Light defoliation was first observed in 1981 on 17,000 acres. Since 1981, the total area of infestation dropped to 14,580 acres, but there was a notable increase of moderate to heavy levels of defoliation. Egg mass surveys were conducted in the Stump Hollow area east of Interstate 89 in Logan Canyon. The purpose of this evaluation is to (1) describe the current situation; (2) discuss projected losses in the future; and (3) provide recommendations for management alternatives for minimizing future losses to the western budworm.

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EXPERIMENT STATION

TECHNICAL INFORMATION

Insect - Western budworm, Choristoneura occidentalis Freeman.

Host - Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
White fir, Abies concolor (Gord. and Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry.

Life History - The western budworm usually develops from egg to adult in 12 months. The moths emerge from pupal cases in August or early September. Females deposit egg masses on the underside of current year needles of host trees in August. Egg masses are oval, light green, and about 1/16 inch long. Eggs hatch in about ten days. Emerging larvae are light green with brown heads and do not feed, but spin silken shelters (hibernacula) in which they remain dormant over winter. Larvae emerge from their winter shelter in the spring, early May to late June, and move to the previous years foliage where they feed for 7 to 14 days. About the time buds start to swell, larvae leave the old needles, bore into expanding buds, and feed upon the new growth. Larvae are full grown within 30 to 40 days, June to early July. They are 25-32mm long, and have a brown head and body with prominent ivory colored spots. Mature larvae pupute in June and July (Furniss and Carolin, 1977).

Evidence of Infestation

1. Young larvae feeding on newly expanding buds and strobile.
2. Mature larvae consuming current year's needles.
3. Shoots webbed together by larvae.
4. Webbed shoots turning brown and falling from trees.
5. Defoliation most evident in upper crowns of trees.
6. Trees dying from top downward after several years of heavy defoliation.

Extent of the Defoliation in 1983 - Defoliation detected during the aerial survey amounted to 14,580 acres on the Logan District. The severity of infestation was categorized as light, moderate and heavy. Acres of infestation are : Light--10,160; Moderate--4,420; Heavy--0; Total--14,580. Areas of visible defoliation on the Logan District of the Wasatch-Cache National Forest occured from the Temple Peak area north to Swan Flat. These areas of defoliation are shown on Figure 1.

BIOLOGICAL INFORMATION

Relative Abundance of Pest

Methods - Egg mass surveys were conducted in mid-September to provide an indication of larval densities and corresponding defoliation expected to occur in 1984. Samples were taken from 24 randomly distributed plots within the infestation (Figure 2). The stand selected was infested and homogenous as to size, class, and species composition.

Plots were established at ten chain intervals along an azimuth determined from photos and maps. At each plot three sample trees were selected and two branches (70 cm. in length) were cut from opposite sides of the midcrown. The sample trees had to meet the following criteria: Douglas-fir; dominant or codominant; 30-50 feet in height; relatively open grown with a full crown; and some budworm feeding evidence, but the tree could not be severely defoliated or top-killed. Each branch was individually bagged in large cloth bags, tied, labeled and transported to a laboratory for examination.

In the laboratory, the branches were measured for length, width and grid area in cm^2. The foliage was then examined under ultraviolet light for budworm egg masses. Needles bearing egg masses were separated in labled containers and examined under a microscope to determine new, old, or parasitited eggs.

Defoliation predictions for 1984 were determined from the number of new egg masses per square meter of foliage (EM/m^2), as calculated using the following formula:

EM/m^2 = Number of new egg masses ÷ {(Branch Length cm x Branch Width cm)/2 x 10,000 cm^2}

Defoliation predictions for 1984 were also determined from the density of 1983 egg masses, using the following information developed by McKnight et al. (1970):

Egg mass density (EM/m^2)	Predicted defoliation class [a/]
<1.55	Undetectable for all infestations
1.71 to 6.20	Undetectable for "static" infestations Light for "increasing" infestations
9.30 to 31	Light for "static" infestations Moderate for "increasing" infestations
>34.10	Moderate for "static" infestations Heavy for "increasing" infestations

a/ Defoliation class limits (percent of new growth)
Undetectable = < 5 percent
Light = 5 to 35 percent
Moderate = 35 to 65 percent
Heavy = > 65 percent

Results and Discussion - Egg mass survey data and predicted defoliation for the sample area are presented in Table 1. Egg mass densities were extremely high with an average of 47 egg masses per meter square of foliage. This figure represents a very heavy predicted defoliation for the upcoming year, which may cause the physiological functions of the attacked trees to be maintained by the lesser photosynthetic active older needles. This change in tree physiology will result in loss of tree growth and vigor, and will become even more significant as the loss of current season needles continues for two or more years (Johnson and Denton).

As heavy defoliation continues, the life and structure of affected trees will deteriorate by the following process:

1. Stems produce less wood.
2. Fewer vegetative buds, flowers, and cones are produced.
3. Parts of the aerial and root structures die.
4. Abnormal budding develops that may deform both crown and stems.
5. Root rots and bark beetles may subsequently infest weakened trees.
6. Whole trees may die.

MANAGEMENT ALTERNATIVES

No Action - With this approach, the outbreak would be allowed to run its course until a population collapse occurred from a combination of: (a) a lack of foliage to maintain a larval population; (b) unfavorable weather conditions; (c) heavy predation and parasitism; and (d) a microbial epizootic. The following adverse and beneficial effects of the outbreak would have to be accepted:

1. This alternative would not be effective in preventing additional tree damage. Impacts to resource values and uses caused by the budworm would have to be accepted under this alternative. Although damage resulting from the western budworm in Utah is not completely known, damage similar to those estimated for the Pacific Northwest could occur if the outbreak continues unabated (Parker 1979). Resultant damage occurring over a typical 10 to 15-year outbreak include the following:

Tree damage	Maximum loss (percent)
Growth loss	30
Understory mortality	25
Sawtimber mortality	5
Topkilling	25
Cone crop reduction	90+
Christmas tree-use reduction	90+

2. There would be no direct costs associated with selection of this alternative, although timber values will be affected and revenues reduced when severely damaged stands are harvested. Also, the depletion of the understory could necessitate the expenditure of funds for reforestation.

3. Visual qualities and economic and social impacts would continue if this alternative were selected.

Silvicultural Management - The main objective of this alternative is to promote effective timber management of the mixed-conifer type to reduce the impact of the western budworm and other forest pests. Thus, stand conditions that reduce tree damages over the long term are created. For example, prescriptions should: (a) open up stands by logging, thinning, and burning; (b) maintain stand densities favoring lodgepole pine and aspen; (c) favor prescribed burning to reduce the percentage of firs and Engelmann spruce; (d) regenerate stands by artificial means, using lodgepole pine stock; (e) favor evenaged stands; and (f) salvage damaged and insect-killed trees.

Effects of this alternative are:

1. The trend of the current outbreak would not be changed if a silvicultural program was initiated. Tree damages would be similar to those listed under the "No Action" alternative; however, topkilling and mortality to understory regeneration could be reduced in areas entered during the current outbreak.

2. Visual qualities and economic and social impacts would continue if this alternative were selected.

Direct Suppression - Aerial application of a pesticide registered by the U.S. Environmental Protection Agency (EPA) could be made to suppress all or part of the outbreak on the Forest. However, if only part of the infestation is treated or if adjoining lands are not treated, one or two additional treatments may be required during the infestation cycle since treated stands could be reinfested from nearby untreated areas.

Application would be carefully timed to the development of the larvae and bud flush; i.e., when 20 percent of the larvae are in the fifth and sixth instars and buds are 85 to 90 percent flushed. This would insure maximum effectiveness with a minimum dosage of insecticide. An application of this type is designed to utilize indigenous natural control agents to further reduce and maintain the budworm population at a low level.

Effects of this alternative are:

1. If a direct suppression program were to be carried out on the Forest in 1984, tree damages and losses could be reduced in areas where permanent tree damages have not yet occurred. However, once permanent tree damages have occurred, the direct suppression alternative may no longer be practical.

2. Although there would be immediate costs associated with the application of a pesticide, about $10-per-acre positive benefits could be achieved by preventing additional effects to timber and recreational activities.

3. Adverse environmental effects resulting from the application of a pesticide would be minimal and temporary.

Insecticides registered for use against the budworm follow:

1. Carbaryl (carbamate insecticide)

The Sevin 4 oil formulation of carbaryl has given consistently satisfactory results in suppressing budworm outbreaks throughout the West for a minimum of 3-4 years. Carbaryl is a nonpersistent pesticide which is available for general use. One pound of active ingredient per acre is the registered dosage rate, and no lasting environmental effects have been identified at this application rate.

2. Acephate (organophosphate insecticide)

Orthene is a nonpersistent insecticide registered for use against the western budworm and other forest defoliators. This insecticide was successfully used against the budworm on the Boise National Forest in 1979.

3. Malathion (organophosphate insecticide)

Malathion is a nonpersistent, broad-spectrum insecticide, registered for use against more than 100 insects, including the western budworm. However, it is not recommended because it has yielded inconsistent results in suppressing outbreaks.

4. Microbial Insecticides

Microbial insecticides such as Bacillus thuringiensis Berliner (B.t), a bacterium, and viruses need further testing and field evaluation before they are ready for use. In 1981, two B. t. formulations were pilot tested by the USDA Forest Service and New Mexico Departments of Agriculture and Natural Resources near Eagle Nest, New Mexico. Preliminary results show that larval mortality was greater in sprayed areas than in check blocks. If treatment is necessary, B.t. could be used in sensitive areas, such as along waterways and near lakes and near specific wildlife areas.

Treatment of High-Value Trees - In recreation areas, VIS centers, and other areas where defoliation of high-value trees would be unacceptable, individual or small groups of budworm-infested trees could be treated by a ground application of an EPA-registered insecticide to reduce the larval density and prevent the adverse effects of defoliation.

Effects of this alternative are:

1. Because only selected high-value trees within an infestation would be treated, this would require annual applications during the outbreak cycle, since treated trees would be reinfested from the nearby infestation.

2. Application costs associated with this alternative would have to be accepted.

3. Adverse environmental effects would be minimal and temporary.

RECOMMENDATIONS

Management of the Current Western Budworm Outbreak - Recommendations for managing the western budworm are based on the age, extent, and intensity of the current outbreak. In the past 3 years, the outbreak has caused scattered, light-to-moderate defoliation with some patches of heavy defoliation on the Logan District. If the current outbreak should continue or intensify, subsequent unacceptable losses due to growth reduction, topkill and mortality, may accrue. Tree mortality over the course of the outbreak will probably be less than 15 percent. Since the primary function of the affected area is recreation/aesthetics, losses from the current outbreak may be acceptable versus the cost of suppression. The outbreak should be monitored each year to determine extent and intensity. If losses become unacceptable to management in subsequent years, suppression activities can be initiated.

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Table 1. EGG MASS SURVEY AND PREDICTED DEFOLIATION FOR LOGAN CANYON, WASATCH NF, UTAH - 1983.

Plot #	Branch 1	Branch 2	Branch 3	Branch 4	Branch 5	Branch 6	Average EM/m^2	Egg Mass Plot	Egg Mass Plot	Predicted Defoliation for 1984
B-1	32.65	24.49	38.10	00.00	10.39	11.43	19.51	15	5	Moderate
B-2	47.62	16.33	21.43	24.89	14.29	14.29	23.14	17	7	Moderate
B-3	00.00	11.43	11.43	21.43	8.16	19.05	11.92	8	14	Moderate
B-4	35.71	35.71	19.05	21.43	22.86	34.29	28.18	26	28	Moderate
B-5	34.29	24.49	28.57	24.49	102.86	92.86	51.26	37	37	Heavy
B-6	28.57	7.14	122.45	21.43	38.10	14.29	38.66	28	2	Heavy
B-7	35.71	28.57	9.52	28.57	28.57	57.14	31.35	19	15	Moderate
B-8	44.44	8.16	16.33	38.10	21.43	57.14	30.93	26	38	Moderate
B-9	30.77	10.26	100.00	71.43	22.22	82.54	52.87	44	30	Heavy
B-10	114.29	85.71	125.71	122.45	64.29	50.00	93.74	77	49	Heavy
B-11	155.10	131.43	42.86	114.29	114.29	165.08	120.51	104	73	Heavy
B-12	171.43	148.57	85.71	54.42	95.24	114.86	111.71	60	65	Heavy
T-1	12.12	40.00	48.48	24.24	8.77	43.60	29.54	14	10	Moderate
T-2	86.10	00.00	45.71	44.44	51.43	22.86	41.76	26	23	Heavy
T-3	102.86	24.49	123.02	171.43	8.79	7.14	72.96	46	38	Heavy
T-4	178.57	64.29	21.43	00.00	00.00	19.05	47.22	39	68	Heavy
T-5	44.44	58.33	105.45	41.54	91.67	110.70	75.36	47	31	Heavy
T-6	63.49	116.20	14.29	80.00	44.44	28.57	57.83	41	37	Heavy
T-7	32.65	61.54	22.86	66.67	130.77	133.33	74.64	54	21	Heavy
T-8	36.90	20.51	26.36	30.77	17.58	50.00	30.35	23	10	Moderate
T-9	35.15	19.05	22.86	61.50	20.51	9.52	28.10	16	15	Moderate
T-10	24.49	16.33	57.14	64.29	76.19	28.57	44.50	38	26	Heavy
T-11	16.33	9.52	00.00	46.15	00.00	00.00	12.00	6	50	Moderate
T-12	26.36	77.78	25.00	38.10	69.23	46.15	47.10	32	22	Heavy

Species surveyed: Douglas-fir B - Bottom Survey Line T - Top Survey Line EM - Egg Mass

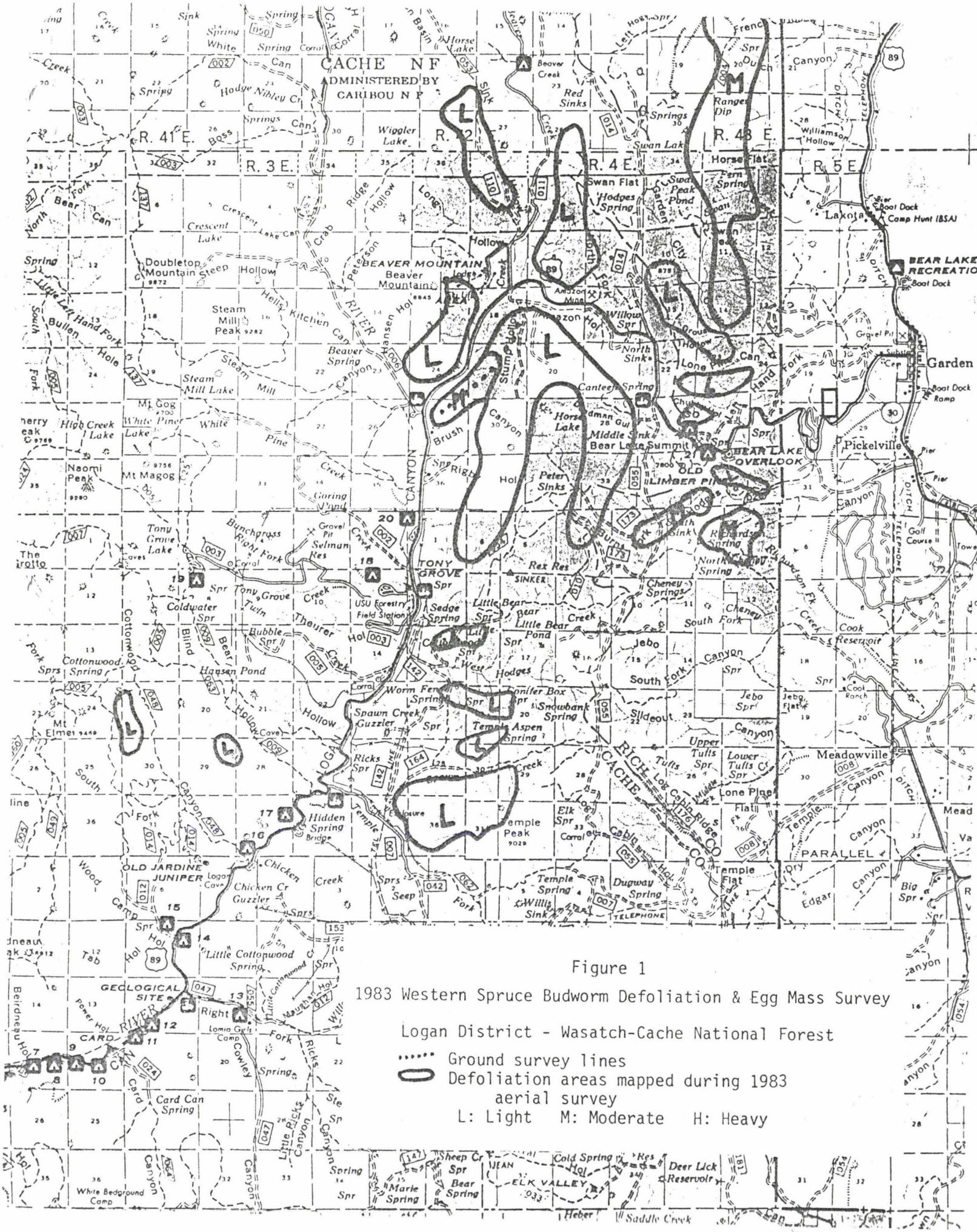

Figure 1

1983 Western Spruce Budworm Defoliation & Egg Mass Survey

Logan District - Wasatch-Cache National Forest

..... Ground survey lines

Defoliation areas mapped during 1983 aerial survey

L: Light M: Moderate H: Heavy

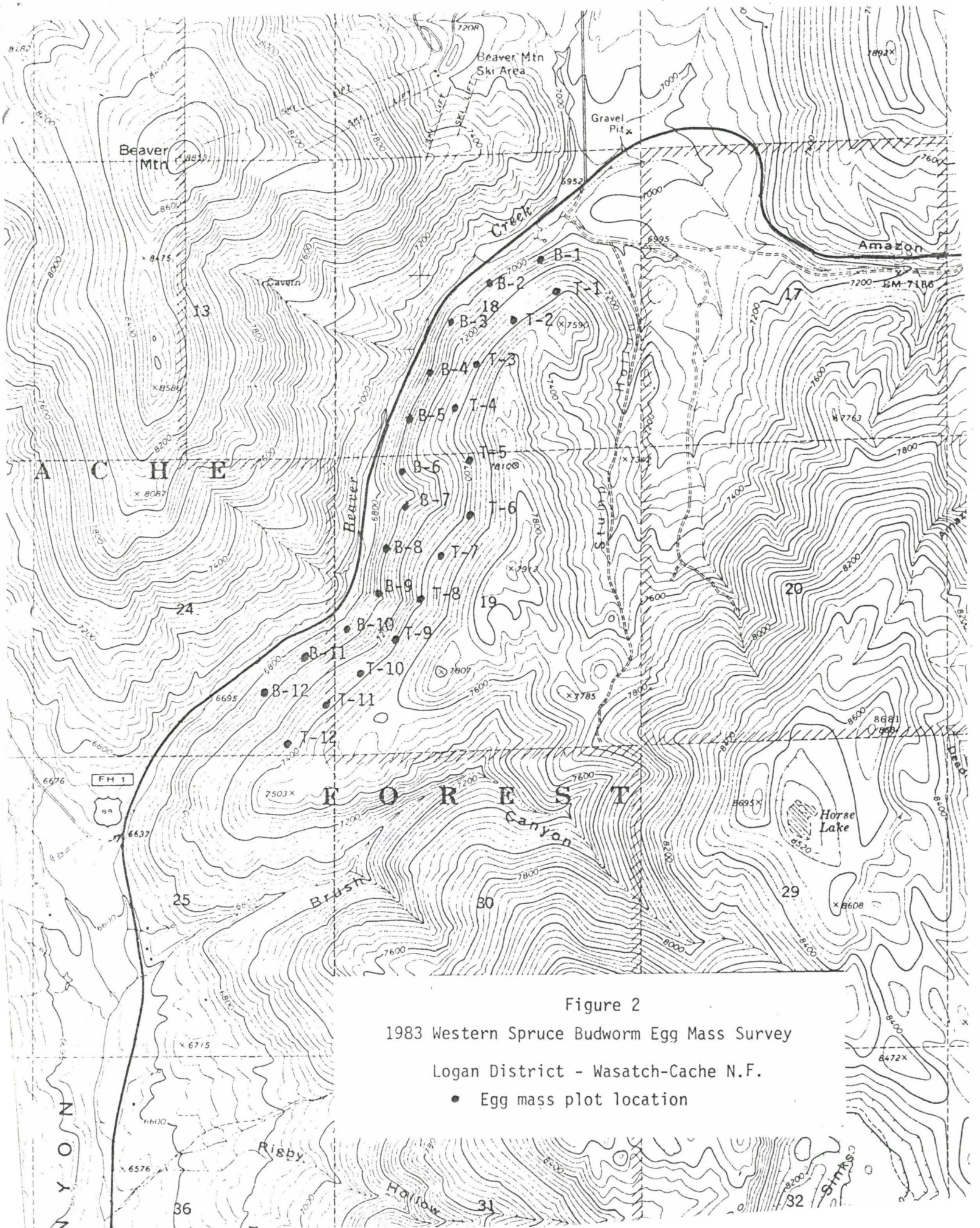

Figure 2

1983 Western Spruce Budworm Egg Mass Survey

Logan District - Wasatch-Cache N.F.

• Egg mass plot location